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Understanding Anisotropic Highlights for Interactive Appearance Editing

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Goals

- Understand the shape of **anisotropic highlights** on arbitrary objects
- Infer local **BRDF orientations** from user-specified highlight shapes

The shape of anisotropic highlights

$$\ell(\varphi) = \mathcal{R}_{\pm\frac{\pi}{2}} \left[\overbrace{\nabla\varphi \bar{\mathbf{v}}(\varphi)^T}^{\text{BRDF Orient. Variations}} \underbrace{\mathbf{W}\bar{\mathbf{u}}(\varphi)}_{\text{Surf. Normal Variations}} \right] \mathbf{h}$$

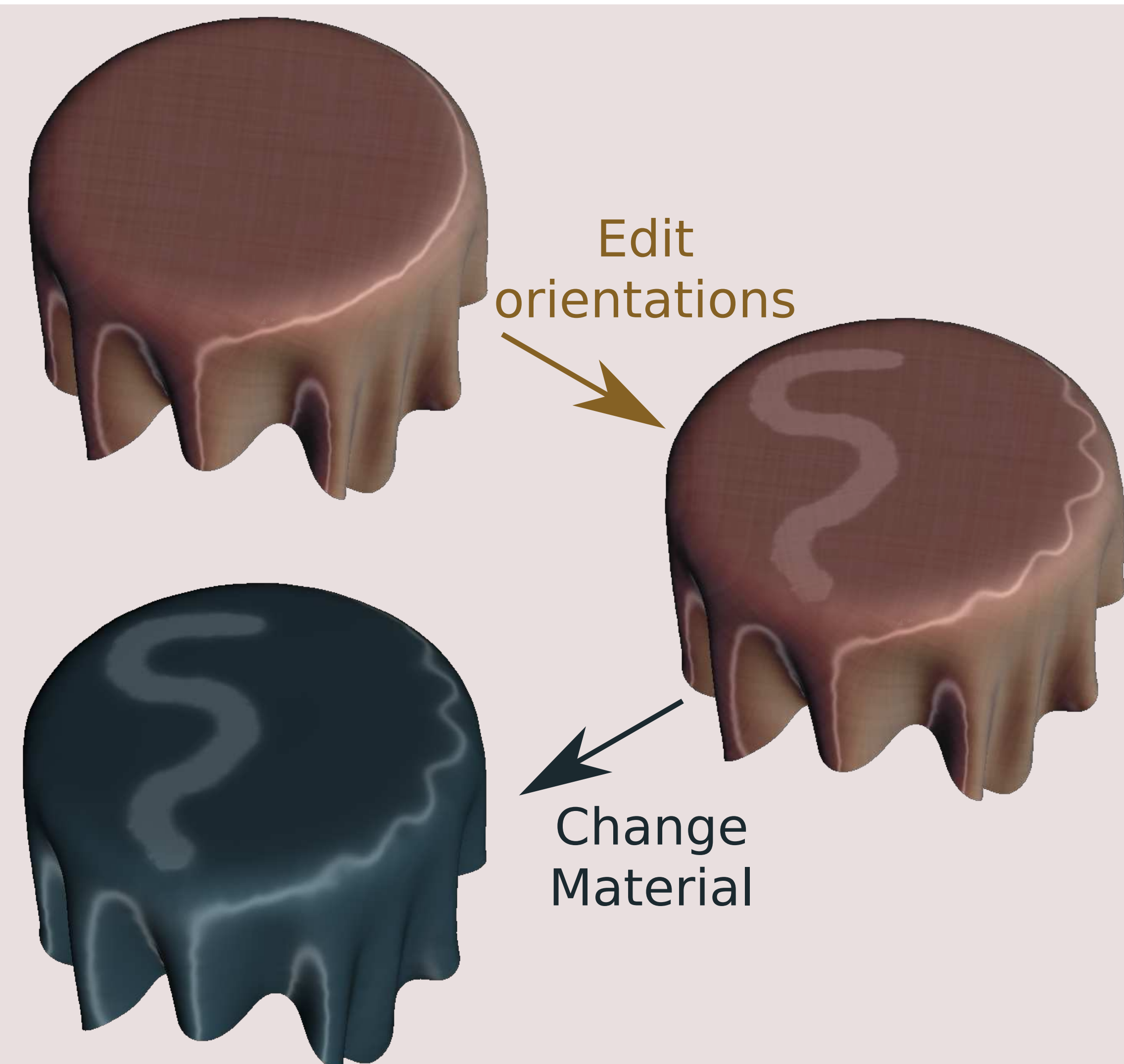
Highlight Tangent

BRDF Orientation

BRDF Orient. Variations

Surf. Normal Variations

Halfway vector



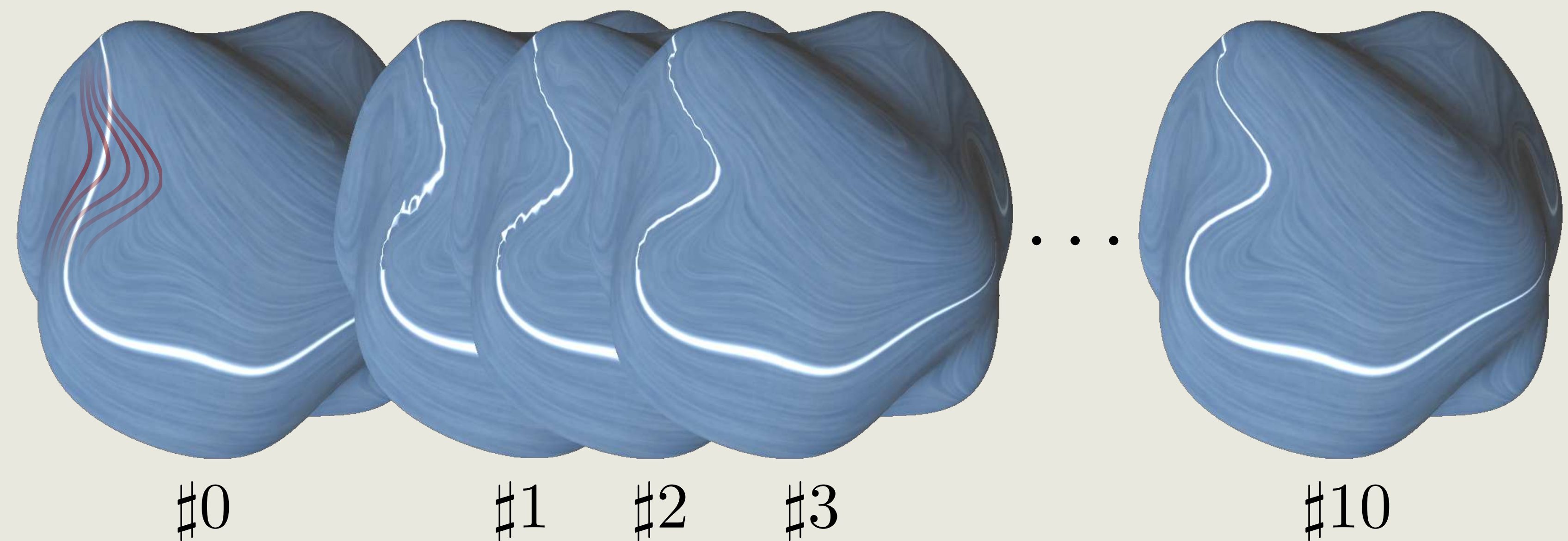
The shape of anisotropic highlights is modified independently of the type of material.

Highlight tangent field depends on variations...

... of *BRDF orientations* (geodesic curvature & splay)

... of *surface normals* (directional curvature & torsion)

Our non-linear solver optimizes BRDF orientations φ to yield the desired highlight tangent field ℓ



Highlights deformed into their desired shape (red curves) in a few iterations.

Highlight manipulation tools

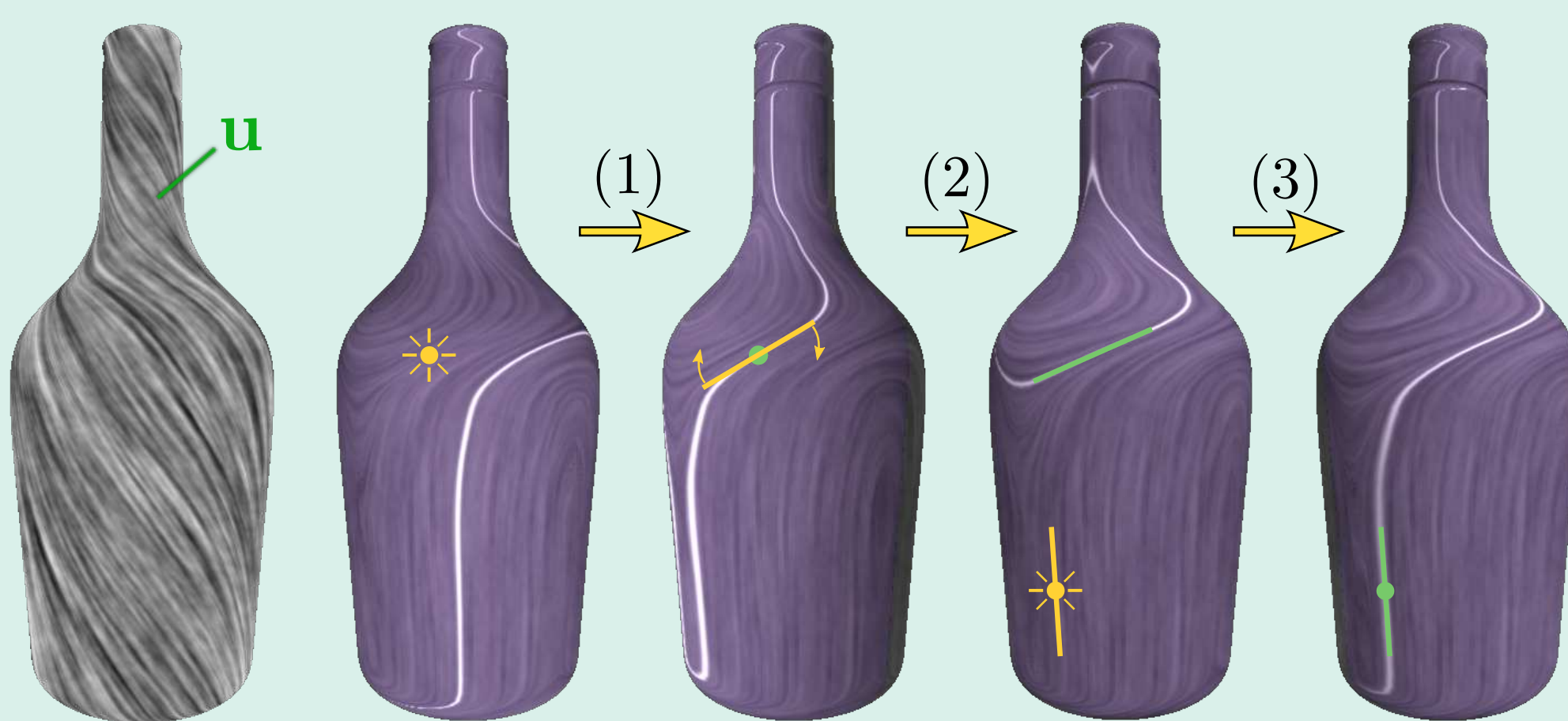
Warp tool

Deform the highlight tangent field to deviate trajectories of highlight curves



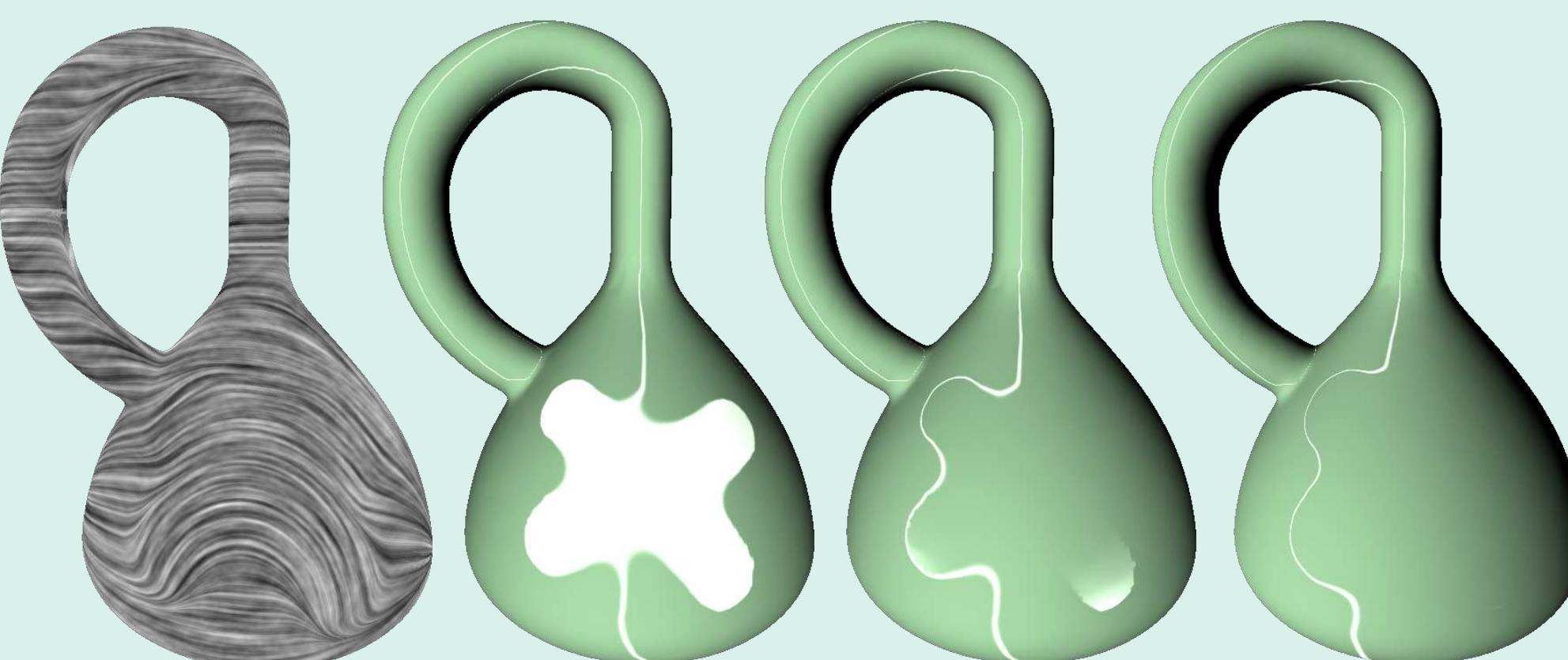
Light tool

Retrieve a light source given a point/tangent constraint for the highlight curve

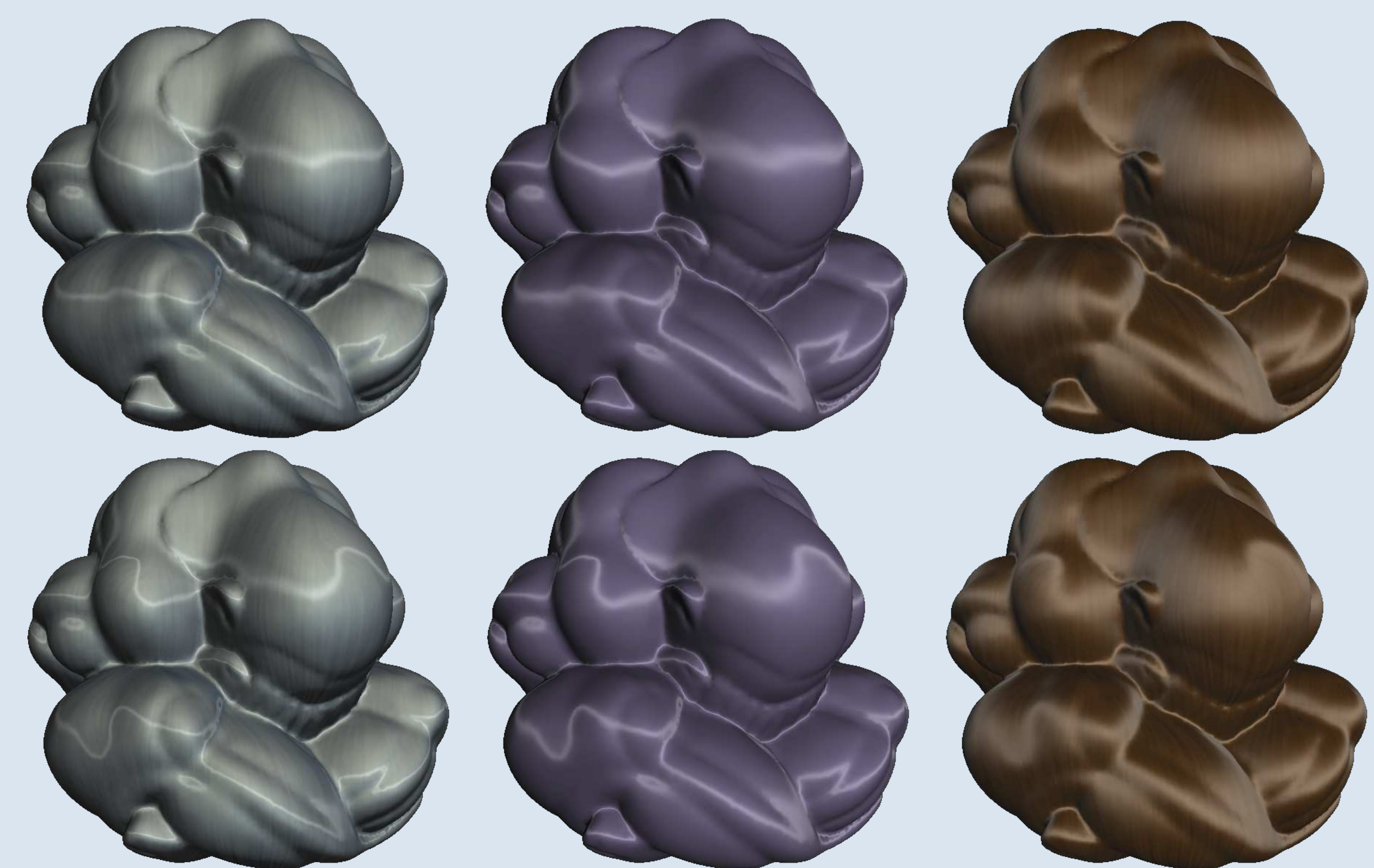


Stencil tool

Paint a degenerate highlight region that quickly vanishes when lighting is rotated



Additional results



Brushed steel Satin fabric Brushed bronze

Top/bottom row: initial/edited highlights.
Manipulations are preserved across material changes.



Manipulated highlights are preserved even in complex scenes rendered with global illumination.

Conclusions

- Provide **explicit relations** between highlights, lighting and surface properties.
- Future work: investigate **relevance** of highlight tangent formula to Human Vision.